NEW STORAGE FOR SURFACE WATER AND AQUIFER RECHARGE

AWSE SPRING WORKSHOP June 12, 2008

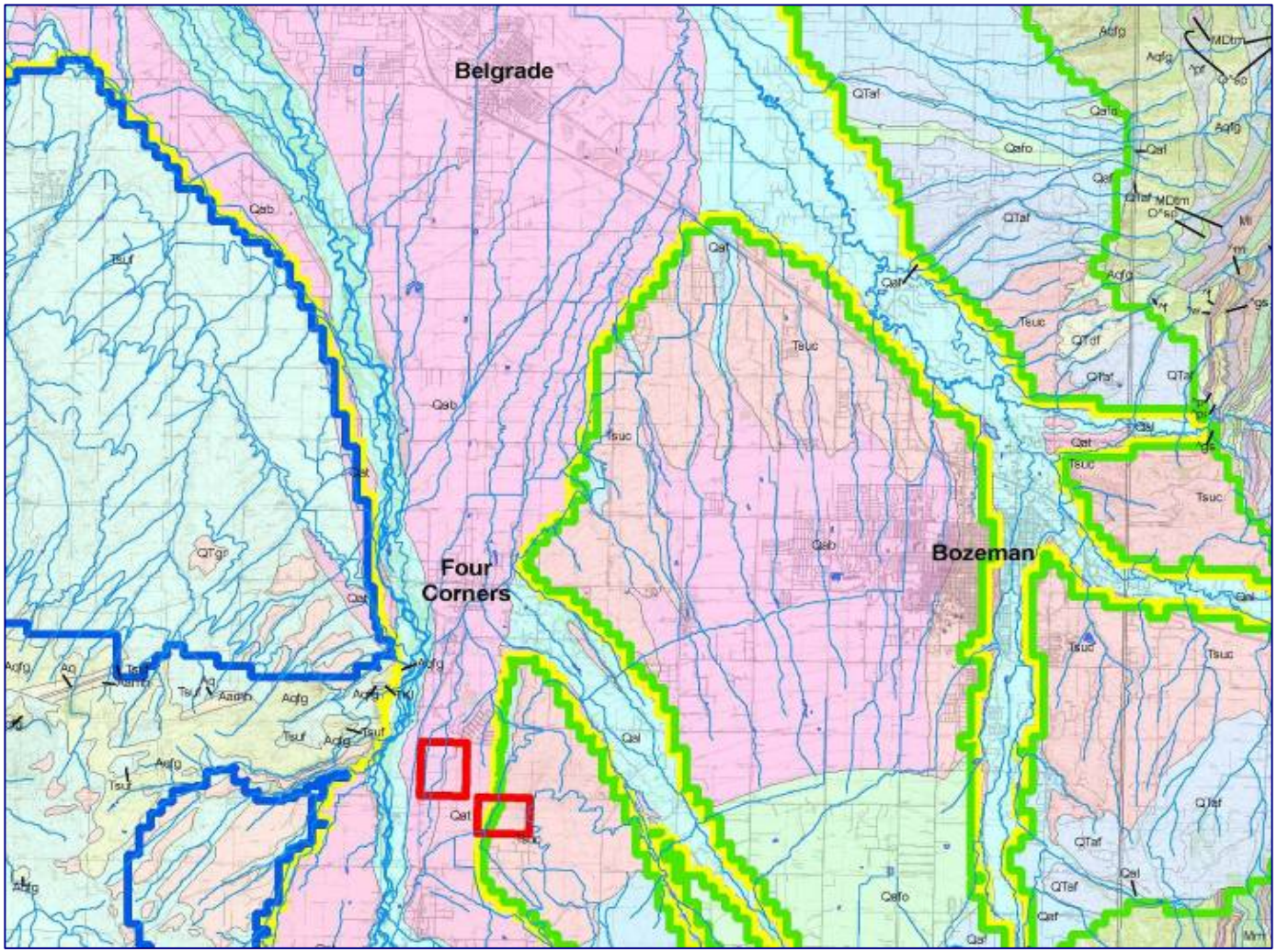
CASE STUDY:

UPPER GALLATIN VALLEY WATER SUPPLY

JOHN DUNLAP — **FLYING A HOLDINGS**

JIM POTTS — **HKM ENGINEERING**

LOCATION



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COMPLETED WORK

1. HYDROGEOLOGIC SETTING
2. DRILLING PROGRAM
3. GROUNDWATER MONITORING
4. SURFACE WATER MONITORING
5. WATER QUALITY MONITORING
6. AQUIFER TESTING
7. WATER RIGHTS ASSESSMENT
8. GROUND & SURFACE WATER MODELING
9. DRAFT WATER RIGHT APPLICATIONS

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ONGOING WORK

1. SURFACE WATER STORAGE FACILITY INVESTIGATIONS
2. ASR PILOT STUDY
3. WATER RIGHT ASSESSMENTS
4. SURFACE WATER DELIVERY SYSTEMS

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COMPLETED WORK 1

- **HYDROGEOLOGIC SETTING**
  - **Previously published reports.**
  - **Off-Site unpublished investigations.**
  - **On-site investigations.**
    - River Valley Alluvium
    - Unconfined Aquifer
    - Irrigation Season Recharge

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COMPLETED WORK 2

- **DRILLING PROGRAM**
  - **Two test wells.**
  - **Five observation wells that fully penetrate the Quaternary Alluvium.**
  - **Five shallow observation wells located near surface water features.**

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COMPLETED WORK 3

- **GROUNDWATER MONITORING**
  - **Hourly water level monitoring on select wells since August of 2005.**
  - **Three off-site private wells.**
  - **Greater Four Corners Area including MSU's and GCLWQD monitoring network.**

COMPLETED WORK 4

- **SURFACE WATER MONITORING**
  - **Hourly Stage and Bi-weekly flow.**
  - **Farmers Canal (4 stations).**
  - **Elk Grove Slough/Ditch (3 stations).**
  - **Lehrkind Stream (1 station).**

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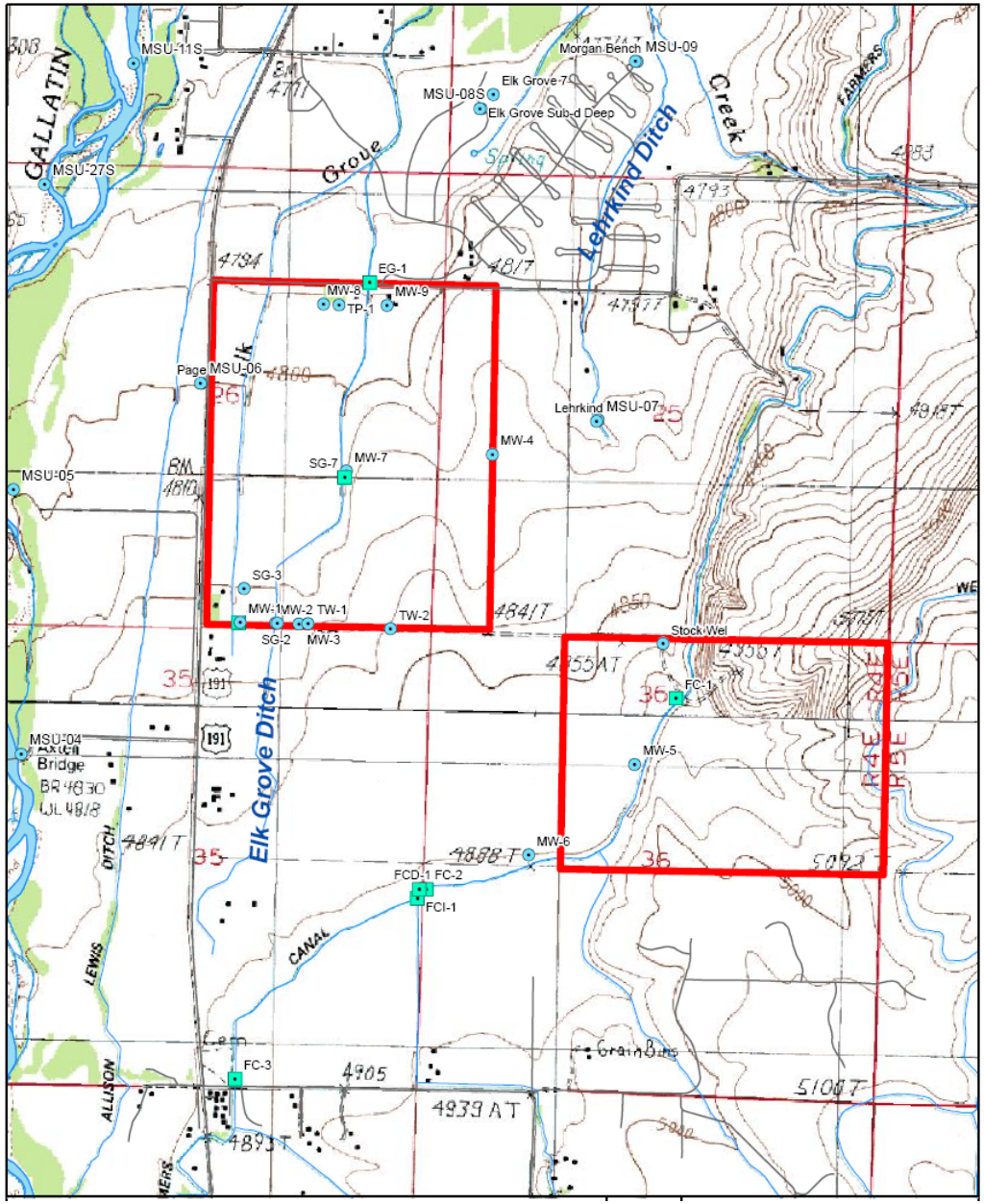

PROJECT SETTING

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COMPLETED WORK 5

- **WATER QUALITY MONITORING**
  - **Surface Water (Farmers Canal).**
  - **Groundwater (on site).**

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COMPLETED WORK 6

- **AQUIFER TESTING**
  - **Two 72-hour constant rate tests.**
  - **Review and incorporation of off site reports.**

Field investigations show both hydraulic continuity and discontinuity between groundwater and surface water features, which changes seasonally.

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COMPLETED WORK 7

- **WATER RIGHTS ASSESSMENT**
  - **DNRC Abstracts.**
  - **DNRC historical records.**
  - **Gallatin County Water Resources Survey.**
  - **Legal Availability Study according to prior appropriation.**
  - **Documenting historical use.**
  - **Historical Aerial photography.**
  - **Operator and Ditch Company interviews.**

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COMPLETED WORK 8

- **GROUNDWATER AND SURFACE WATER MODELING**
  - MODFLOW 2000 with the associated stream package.
    - West Gallatin River
    - South Cottonwood Creek
    - Elk Grove Ditch
    - Lehrkind Ditch
    - Hyalite creek
  - Model simulation included:
    - Regional scale
    - Local scale
    - Long-term (multi-year) effects with a 2-week time step to show greater detail in the timing of pre-stream capture effects and to simulate a shortened irrigation season.

Modeling shows that groundwater pumping will directly deplete surface water systems. Modeling results indicate that depletion can be completely mitigated by injecting surface water into the unconfined aquifer through a recharge well (s) located upgradient of the withdrawal well (s).

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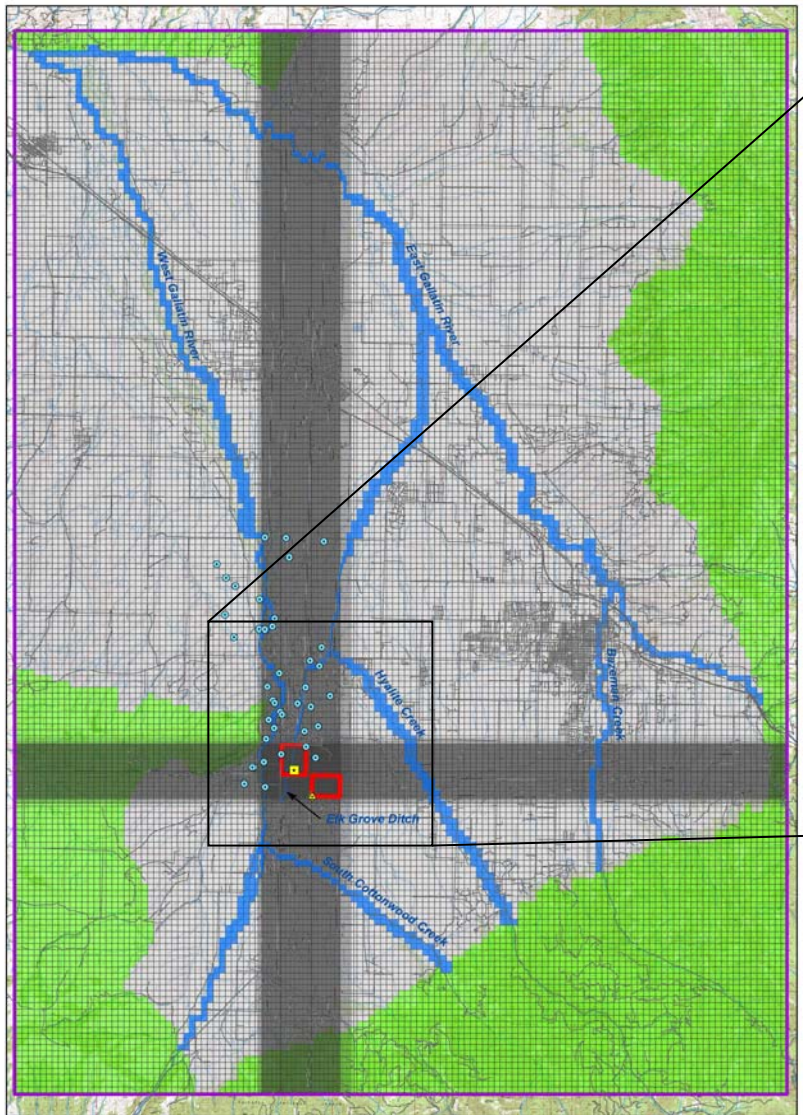
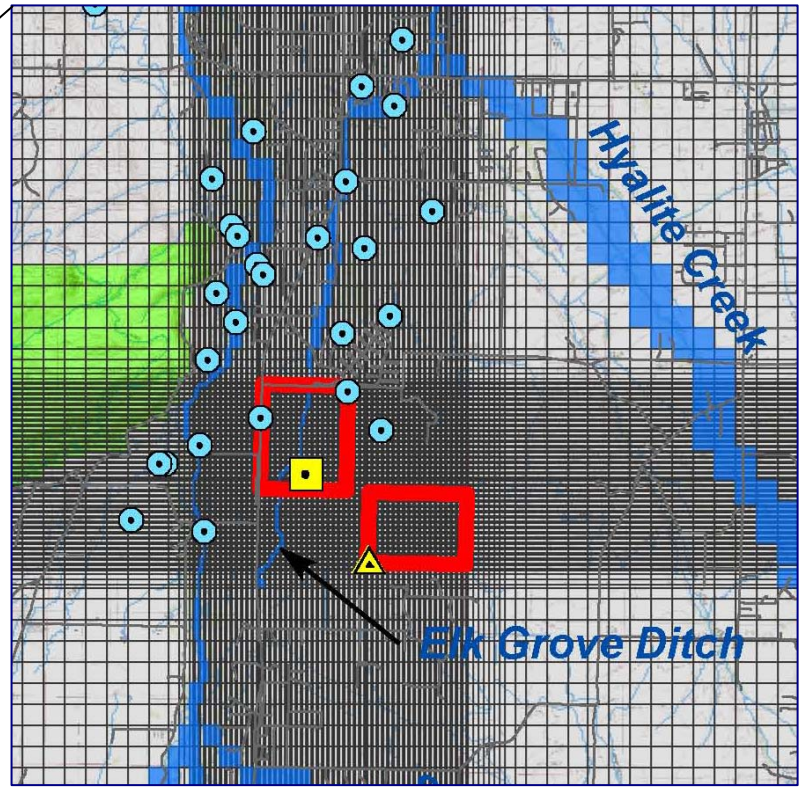
Numerical Model Domains



Regional Boundary



Local Boundary

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COMPLETED WORK 9

- DRAFT WATER RIGHT CHANGE AND BENEFICIAL USE APPLICATIONS
  - Beneficial Use: Domestic, Commercial, potentially Municipal
  - Points Of Diversion (POD)
    - Farmers Canal head gate.
    - New points of diversion for the Aquifer Storage and Recovery (ASR) wells.
  - Period Of Diversion
    - Seasonal according to historical surface water rights.
  - Volume and Flow
    - According to amount available through historical surface water rights.
  - Period Of Use
    - Expand to year round.
  - Place Of Use
    - Remains the same for early phases.
    - Expand as the water distribution system expands.

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ONGOING WORK 1

- **SURFACE WATER STORAGE FACILITY**
  - Investigations are under way to determine the ability to store water in a surface reservoir.
    - Capture early season runoff.
    - Additional storage capacity.
    - Year round use of the stored water.
    - Ability to control releases of water for various uses.

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ONGOING WORK 2

- **ASR PILOT STUDY**
  - Assess alternatives for injection.
  - Assess alternatives for recovering stored water.
  - Pre treatment requirements.
  - Post treatment requirements.
  - Verify modeling assumptions and predictions.

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ONGOING WORK 3

- WATER RIGHT ASSESSMENTS
  - Incorporate other water rights into the system for additional capacity.

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ONGOING WORK 4

- SURFACE WATER DELIVERY SYSTEMS
  - Investigating the best alternatives for delivering water to the ASR site and / or a Surface Water Storage facility.
  - Investigating the best alternatives for delivering potable / municipal to a distribution system.

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PROJECT STATUS

- Surface Water Storage Facility Investigations
- ASR Pilot Studies
- Ongoing Monitoring
- Planning and Feasibility Analyses
- Finalize Change and New Applications to Comply With Closed Basin Law

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